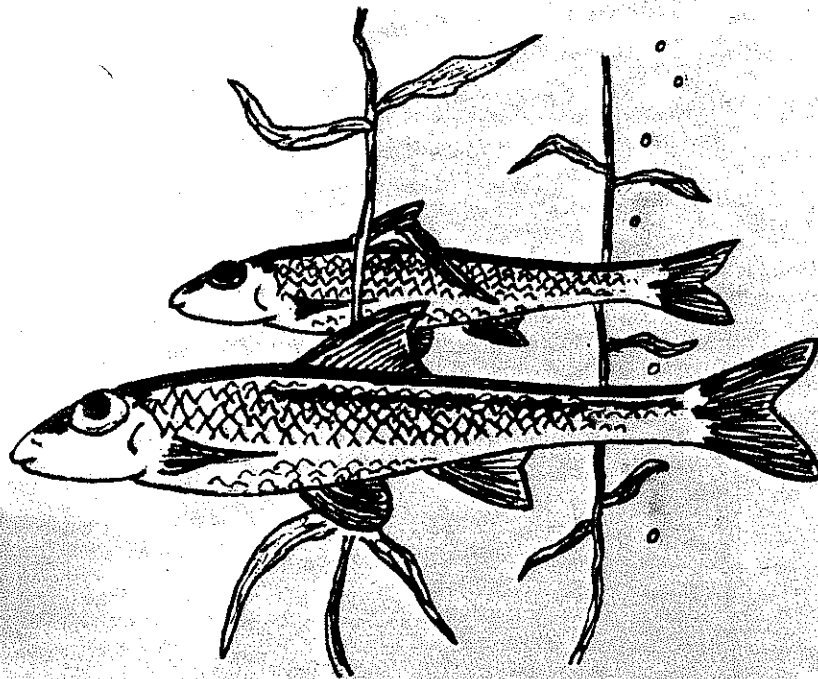


Recovery Plan

Slender Chub (Hybopsis cahni)



RECOVERY PLAN
SLENDER CHUB (Hybopsis cahni) (Cope)

Prepared by
Asheville Endangered Species Field Station

U.S. Fish and Wildlife Service
Region 4, Atlanta, GA

June 1983

Approved: _____

J. Eugene Hester
Director, U.S. Fish and Wildlife Service
Acting

Date: _____

July 29, 1983

THIS IS THE COMPLETED SLENDER CHUB RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES, AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS WHO PLAYED A KEY ROLE IN PREPARING THIS PLAN. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

ACKNOWLEDGEMENTS SHOULD READ AS FOLLOWS:

U.S. Fish and Wildlife Service. 1983. Slender Chub Recovery Plan.
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PART I

INTRODUCTION

The slender chub (Hybopsis cahni) is endemic to the upper Tennessee River in Tennessee and Virginia. Presently, the species is known to exist at five sites on the Powell River and four on the Clinch River (Figure 1). Two populations once known from the Clinch River have been extirpated and the only population known from the Holston River is gone (Etnier, et al. 1979). These populations were lost primarily from the effects of impoundments. The remaining populations are threatened primarily by coal related siltation, poor land use practices, gravel dredging, and toxic chemical spills.

The species was first collected by Evermann and party in 1893 (Evermann and Hildebrand 1916). However, they did not recognize it as a new species and the fish was not described until 1956 by Hubbs and Crowe (1956).

The slender chub was listed as a Threatened species under the Federal Endangered Species Act and the notice was published in the September 9, 1977 Federal Register, Volume 42, No. 175, pages 45527 to 45529. Concurrently with that listing, Critical Habitat was also designated to include the following:

Tennessee - Claiborne and Hancock Counties. Powell River,
main channel from backwaters of Norris Lake upstream to the

Tennessee/Virginia state line. Clinch River, main channel from backwaters of Norris Lake upstream to the Tennessee/Virginia state line.

Virginia - Lee and Scott Counties. Powell River, main channel from the Tennessee/Virginia state line upstream through Lee County, Virginia. Clinch River, main channel from the Tennessee/Virginia state line upstream through Scott County, Virginia.

Historical and Present Distribution

The slender chub is known from collections in three rivers of the upper Tennessee River drainage: the Clinch, Powell, and Holston rivers.

Holston River, Tennessee - The species presently is not known to exist in this river. One slender chub was collected from the Holston River near an island 4.8 kilometers above Three Springs (September 1941). This collection was part of a Cherokee Reservoir preimpoundment study. The area where the fish was taken is now within the reservoir.

Since 1941, 69 collections at 14 sites have been made in unimpounded parts of the main stem Holston River but none have yielded slender chubs. Burkhead and Jenkins (1982) reported the preimpoundment surveys were likely made using rotenone and seines while later surveys were conducted by experienced crews from TVA and the University of Tennessee utilizing seines, electroshockers and ichthyocides. They further stated they considered these

efforts to represent a valid assessment of the ichthyofaunal composition at the sampling sites.

Although no population is presently known from the Holston River, habitat for reintroduction may be available below Cherokee Reservoir. The Holston River was selected for snail darter transplants as the river was believed to contain suitable habitat for that species (Hurst, et al. 1979).

Clinch River, Tennessee and Virginia - Burkhead and Jenkins (1982) reported on 91 collections at 19 sampling sites in the Clinch River. These collections span more than 100 years from 1874 to near present and represent samples from the Clinch River between rkm 37.2 and 353.0. The slender chub was taken in 33 of these collections at six Tennessee sites. This represents a historical Clinch River distribution of about 176 rkm. The present range is restricted to a 27.7 rkm section above Norris Reservoir where the species is now known from four sites in Tennessee. The fish may have existed in Virginia sections of the Clinch River, but no records are available.

The two sites on the Clinch River where the species was extirpated were located at rkm 202.7 and rkm 127.9. The upper site is now within the pool of Norris Reservoir. The lower site was located just below the now-present Norris Dam where cold water releases from the reservoir have allowed for the creation of a cold water trout fishery.

The four presently known Clinch River collection sites are located at: Swan Island (rkm 277.0), Frost Ford (rkm 291.6), Brooks Island (rkm 295.3) and

Kyles Ford (rkm 304.7), all in Tennessee. Burkhead and Jenkins (1982) reported that the river sections between Swan Island and Frost Ford and from Kyles Ford upstream into Virginia to rkm 353.0 apparently lack the fishes' preferred habitat of large shoals composed of small to medium sized gravel. The river reach below Swan Island to Norris Reservoir, about 31.6 rkm, has limited access and has been sampled only at three localities. They reported further searches here may uncover other inhabited areas, but most of this reach contains unsuitable habitat (pools and extensive bedrock in high gradient areas).

Powell River Tennessee and Virginia - The earliest record of sampling the Powell River was 1876 and the river has been sampled as recently as 1981. A total of 77 collections at 17 sites have located the slender chub at four locations in Tennessee and one in Virginia (Burkhead and Jenkins 1982).

The distribution in the Powell River, like the Clinch, is spotty and appears related to the fishes' preferred habitat of major shoals composed of small gravel which is in limited supply. From Norris Reservoir upstream, the first area where the species has been found is located at Route 25E bridge (rkm 105.1). The next location is about 50 rkm upstream at rkm 153.5 with the other sites at rkm 159.6, 171.8, and 189.3, which is at Fletcher Ford, Virginia.

The Powell River between Poteet Ford, Virginia (rkm 231.4) and Hall Ford, Virginia (rkm 206.8) was surveyed by Jenkins in 1972 (Burkhead and Jenkins 1982). He did not find suitable substrate nor any slender chubs in this river section. However, Burkhead and Jenkins believe additional populated

sites may be discovered in the following areas: From rkm 88.0 to 105.1, 109.1 to 153.5 and 194.0 to 206.8.

In summarizing the distribution of the species, Burkhead and Jenkins (1982) stated: "Hybopsis cahnii, an endemic to the upper Tennessee River drainage in Tennessee and Virginia, exhibits one of the most diminutive current and historical ranges of any eastern North American cyprinid. It is known from 27.7 and 84.2 rkm sections of the Clinch and Powell Rivers, respectively, totaling 111.9 rkm, but actually is known only at nine localities. Its former distribution undoubtedly included several Holston River populations although it is only known from one specimen from an extinct population. The true historical range of the slender chub is undecipherable due to habitat decimation and the paucity of records prior to habitat alterations. In three cases, population sites were permanently altered the same year of discovery. Since it is a large stream species, H. cahnii may have occurred in similar gradient regimes of other major upper Tennessee River tributaries but probably never penetrated higher gradient areas as does the Threatened spotfin chub, H. monacha (Jenkins and Burkhead, ms 1982)."

Description, Ecology, and Life History

The slender chub (see photo) has a moderately elongated body (maximum length 77mm SL, 94mm TL), a long snout, large eyes, and an inferior mouth with one barbel at the posterior tip of each maxillary. The fish has an olive to brownish back, silvery side lacking spots and blotches, a dark lateral stripe (broken at intervals by pale "v"s), and a whitish underside.

The species' preferred habitat from April to September is large (30-125 meter width) warm streams with large shoals composed of pea to medium sized clean swept gravel (Burkhead and Jenkins, 1982). Jenkins (1975) reported that all specimens from which capture data were available were taken in water 0.1 to 1.2 meters deep. Their winter habitat and the habitat of juveniles is unknown.

The food habits of this chub are known from 24 individuals examined by Jenkins (1975). He reported that the species is a benthic feeder consuming insects and mollusks, and he speculated that they feed during daylight. Davis and Miller (1967) and Reno (1969) believed the fish may use sight, enhanced by taste, to locate its food. This assumption is based on brain morphology, cutaneous taste bud development, and the cephalic lateral line system.

Very little is known of their reproductive behavior. Based on gonadal conditions, Jenkins (1975) stated that they probably spawn beginning mid or late April and possibly extending into early June. He stated they likely mature in their third to fourth year of life and that few individuals survive beyond that age.

Reasons for Decline and Threats to Continued Existence

The only known population in the Holston was lost when Cherokee Reservoir was created. The river above the reservoir is impacted by siltation and industrial effluent from Kingsport, Tennessee (Higgins, 1978). The habitat below the reservoir is affected by cold water releases. These factors may

have destroyed other populations once inhabiting the river. These same factors may preclude any efforts to reestablish the species in the Holston.

Two populations were lost in the Clinch River from reservoir development. The Clinch River has also experienced two toxic chemical spills in the past 15 years (Crossman, et al. 1973 and Cairns, et al. 1971). In June 1967, fly ash slurry from a Clinch River steam electric generating plant settling pond spilled into the river. This material (pH 12) killed fish from Carbo, Virginia (rkm 431.2) downstream into Tennessee to Kyles Ford (rkm 304.1). A Tennessee Wildlife Resources Agency report on this fish kill concluded that the kill extended downstream into Tennessee to rkm 266.4 (Stadnyk, 1967). A sulphuric acid spill in June 1970 from the same facility in Carbo killed fish for 22 rkm. Burkhead and Jenkins (1982) reported that if the slender chub were located between Carbo, Virginia and Kyles Ford the spills likely would have eliminated it. Some increases in silt in the form of coal fines have been observed in the Clinch River since 1975 (Ahlstedt, 1982 personal communication) and if this problem increases, further impacts on the species and its habitat can be expected.

The Powell River headwaters are in the heart of coal country and the destructive impacts of coal related siltation are widely evident. Burkhead and Jenkins (1982) found coal fine deposits as deep as one meter in pools and backwater at McDowell Ford (rkm 171.8); however, they reported most runs and riffles were only moderately to slightly impacted. Ahlstedt and Brown (1980) indicated that coal mining activities in the upper Powell River impact the river through deposition of silt and coal fines on mussel beds. With coal in such high demand and anticipated increases in coal utilization

(Freedman, et al.1974), coal related impacts on the Powell River can be expected to increase unless steps are taken to minimize effects on the river. However, even if coal fines and silt from present coal operations and abandoned mine lands could be kept from entering the river, coal fines and silt already present in the upper river may move down and further impact the lower Powell River's fish fauna.

The habitat of the slender chub in all of these rivers is in high demand. Gravel shoals in the Clinch and the Powell Rivers have been dredged. This impacts the fish by removing the limited supply of its preferred habitat.

PART II

RECOVERY

A. Recovery Objectives

The ultimate goal of this recovery plan is to restore viable populations* of the slender chub (Hybopsis cahnii) to a significant portion of its historic range and remove the species from Federal Endangered Species Act Protection. The slender chub shall be considered recovered, i.e., no longer likely to become an Endangered species, when the following criteria are met:

1. Through protection of existing populations and/or by introductions and/or discovery of new populations, there exist viable

populations* in the Powell River, Clinch River and Holston River of the following magnitude:

a. Viable populations exist with a minimum of seven population centers ** on both the Clinch and Powell Rivers. These population centers will be dispersed throughout these rivers so that it is unlikely that a single event would cause the loss of a river's entire population.

b. A viable population is established in the Holston River with a minimum of one population center.

* Viable population - Ten years of population monitoring (biannual sampling) indicates that the species is reproducing and that the population is either stable or expanding.

** Population center - large shoal area of at least 250 square meters composed of small to medium sized gravel inhabited by a viable population of slender chubs.

2. Noticeable improvements in coal-related problems and substrate quality have occurred in the Powell River, and no increase in coal or other energy-related impacts exist in the Clinch River.
3. The species and its habitat in all three rivers are protected from foreseeable human related and natural threats that may adversely affect essential habitat or survival of any of the populations.

B. Step-down Outline:

Prime Objective: Recover the species to the point where it no longer requires Federal Endangered Species Act protection.

1. Preserve populations and currently occupied habitat of the slender chub.

1.1. Continue to utilize existing legislation and regulations (Federal and state endangered species laws, water quality requirements, stream alteration regulations, etc.) to protect the species and its habitat.

1.2. Conduct population and habitat surveys.

1.2.1 Determine species' present distribution and status.

1.2.2 Characterize the habitat and ecological association and determine essential elements (biotic and abiotic factors) of the species' habitat for all life history stages.

1.2.3 Determine the extent of the species' preferred habitat.

1.2.4 Present the above information in a manner which identifies specific areas in need of special attention.

1.3. Determine present and foreseeable threats to the species and strive to minimize and/or eliminate them where necessary to meet the recovery objective.

1.3.1 Determine impacts of coal industry related pollution on aquatic life in the Powell River.

1.3.2 Investigate and inventory other factors negatively impacting the species and its environment.

1.3.3 Solicit information on proposed and planned projects that may impact the species.

1.3.4 Evaluate the potential threat to the species of overcollecting.

1.3.5 Determine measures that are needed to minimize and/or eliminate any adverse impacts and implement where necessary to meet the criteria outlined in the recovery objectives.

1.4. Solicit help in protecting the species and its essential habitat.

- 1.4.1 Meet with local government officials and regional and local planners to inform them of our plans to attempt recovery and request their support.
 - 1.4.2 Work with local, state, and Federal agencies to encourage them to utilize their authorities to protect the species and its river habitat.
 - 1.4.3 Meet with local mining and/or industry interests and try to elicit their support in implementing protective actions
 - 1.4.4 Meet with landowners adjacent to the species' population centers, inform them of the project, and try to get their support in habitat protection measures.
 - 1.4.5 Develop an educational program using such items as slide/tape shows, brochures, etc. Present this material to business groups, civic groups, youth groups, church organizations, etc.
2. Determine the feasibility of reestablishing the species in the Holston River and introduce where feasible and necessary to meet recovery objectives.

- 2.1 Survey to determine the availability and location of suitable transplant sites. This can include areas for population expansion within rivers where the species presently exists.
- 2.2 Investigate and determine the best method of establishing new populations, i.e., introduction of adults, juveniles, artificially raised individuals, or other means or combinations.
- 2.3 Reestablish species where it is likely it will become established and where needed to meet the recovery objectives.
- 2.4 Implement the same protective measures for these introduced populations as outlined for established populations in numbers 1.3 through 1.4 above.
3. Conduct life history studies not covered under section 1.2.2 above, i.e., age and growth, reproductive biology, longevity, natural mortality factors, and population dynamics on a need to know basis.
4. Investigate the necessity for habitat improvement and, if feasible and necessary to meet recovery, develop techniques and sites for habitat improvements and implement.

5. Develop and implement a program to monitor population levels and habitat conditions of presently established populations as well as introduced and expanding populations.
6. Annually assess overall success of recovery program and recommend action (adjustment in recovery objectives, delist, continued protection, implement new measures, other studies, etc.).

C. Narrative Outline:

1. Preserve populations and currently occupied habitat of the slender chub. Introduction of the species back into its former range (Holston River) may be feasible; however, the protection of established populations and their essential habitat is the key to the survival of the species.
 - 1.1 Continue to utilize existing legislation and regulations (Federal and state endangered species laws, water quality requirements, stream alteration regulations, etc.) to protect the species and its habitat. This species, although listed as Threatened, could easily become Endangered if the presently known populations are not maintained.
 - 1.2 Conduct population and habitat surveys.
 - 1.2.1 Determine species' present distribution and status.

Although a recent status review of the species has been completed, some areas of the Clinch and Powell Rivers have not been adequately sampled. The entire range of the species within these rivers must be delineated before proceeding with recovery actions.

1.2.2 Characterize the habitat and ecological association and determine essential elements (biotic and abiotic factors) of the species' habitat for all life history stages. Before the species' habitat can be protected adequately, it must be completely characterized. The summer habitat (gravel shoals) is known for adults, but winter habitat, the requirements of juveniles, and spawning habitat are unknown. Knowledge of the species' habitat will enable the recovery effort to focus management and protection efforts on the habitat and ecological associations required for the survival of the species.

1.2.3 Determine the extent of the species' preferred habitat. Not only is it necessary to know the types of habitat needed, the extent and location of these required habitats must be delineated. By knowing the location of the habitat, protection procedures can be implemented.

1.2.4 Present the above information in a manner which identifies specific areas in need of special attention. The use of maps delineating areas of special concern will allow planners to avoid sensitive areas.

1.3 Determine present and foreseeable threats to the species and strive to minimize and/or eliminate them where necessary to meet the recovery objective. Each river system inhabited by the species will be subject to certain environmental influences which threaten the species and its habitat. To minimize and/or eliminate these threats, where needed to meet recovery, the threats must be identified, they must be correlated with species specific habitat requirements gathered under 1.2.2, and measures must be taken to alleviate the problem areas.

1.3.1 Determine impacts of coal industry related pollution on aquatic life in the Powell River. Coal related siltation is a major water and substrate quality problem in the Powell River. The extent of its impact on this and other aquatic species must be determined. It is likely that recovery of the species in the Powell is not possible without control of this problem.

1.3.2 Investigate and inventory other factors negatively

impacting the species and its environment. Other factors may also have a substantial impact on the species. The effect of toxic spills in the Clinch are well documented but other less obvious factors may be damaging the species' recovery chances. However, other subtle factors such as the impact of pesticides may need to be evaluated in some streams.

1.3.3 Solicit information on proposed and planned projects that may impact the species. If the species is to be delisted, the Service must be assured that there are no proposed and/or planned projects that could likely jeopardize the continued existence of the species. Once all negative factors are assessed, those that are seriously affecting recovery will need to be minimized in order to effect recovery for the species.

1.3.4 Evaluate the potential threat to the species of overcollecting. If over collecting is a threat, methods to control it should be implemented. However, such restrictions should not unduly interfere with legitimate and beneficial research by professional ichthyologists.

1.3.5 Determine measures that are needed to minimize

and/or eliminate any adverse impacts and implement where necessary to meet the criteria outlined in the recovery objectives.

- 1.4 Solicit help in protecting the species and its essential habitat. Section 7 Consultation under the Endangered Species Act and Fish and Wildlife coordination activities can assist in protection of the species, but these programs alone cannot recover the slender chub. The assistance of Federal and state agencies as well as local governments will be essential. Also, support of the local industrial and business community as well as local people will be needed to meet the goal of recovering the species. Without a commitment from the people in these river valleys who have an influence on habitat quality, the recovery effort will be doomed. A concerted effort must be made to reduce the problem of coal fine siltation in the Powell River and the impacts of gravel dredging in both the Clinch and Powell.

1.4.1 Meet with local government officials and regional and local planners to inform them of our plans to attempt recovery and request their support.

1.4.2 Work with local, state, and Federal agencies to encourage them to utilize their authorities to protect the species and its river habitat.

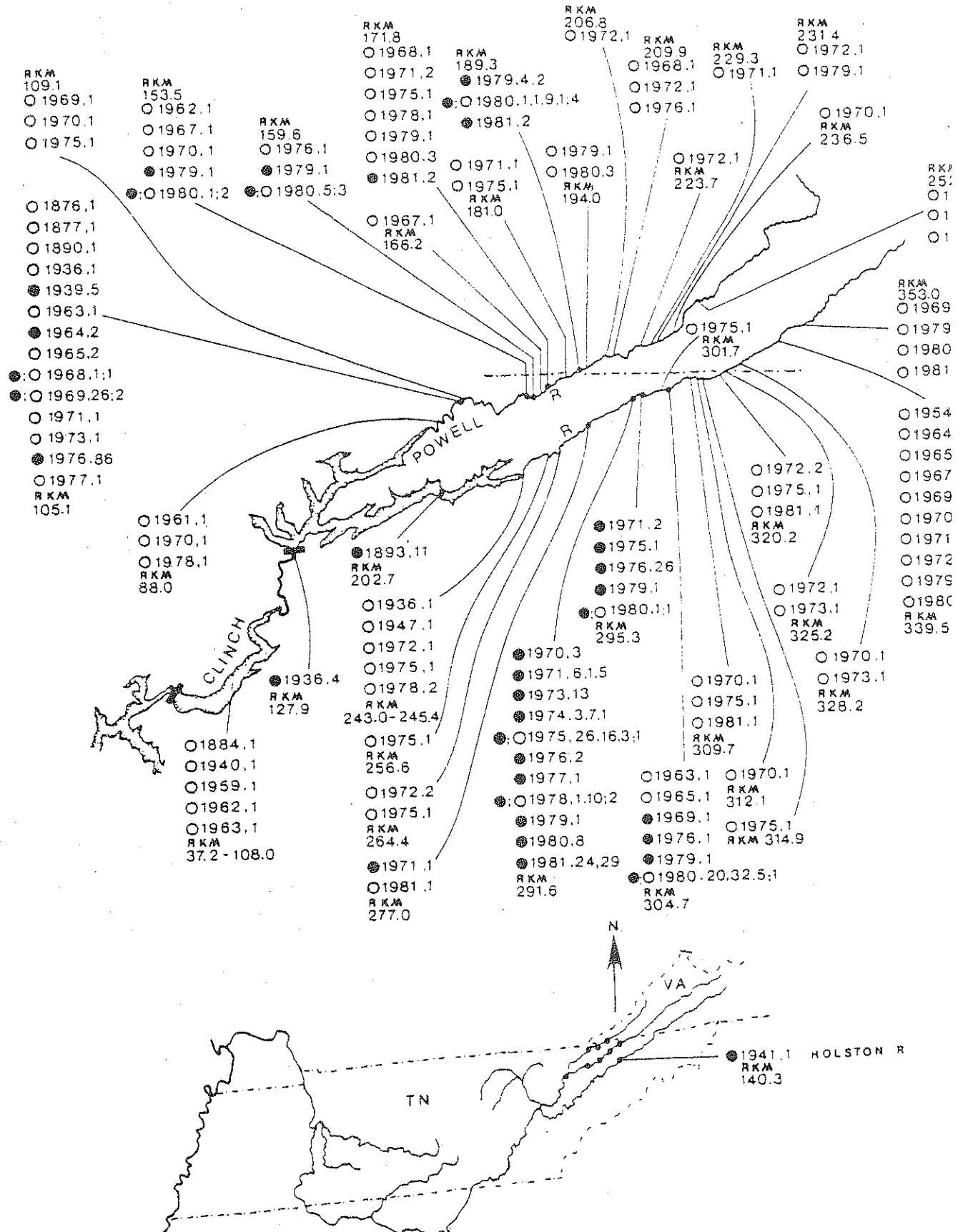
- 1.4.3 Meet with local mining and/or industry interests and try to elicit their support in implementing protective actions.
 - 1.4.4 Meet with landowners adjacent to the species population centers, inform them of the project, and try to get their support in habitat protection measures.
 - 1.4.5 Develop an educational program using such items as slide/tape shows, brochures, etc. Present this material to business groups, civic groups, youth groups, church organizations, etc. Educational material outlining the recovery goals with emphasis on the other benefits of maintaining and upgrading habitat quality will be extremely useful in informing the public of our actions.
2. Determine the feasibility of reestablishing the species in the Holston River and introduce where feasible and necessary to meet recovery objectives. Introductions may be necessary in order to increase the number of populations of slender chubs and thus increase the security of the species. Introductions may also be useful to accelerate the expansion of the species within the Powell River and Clinch River.

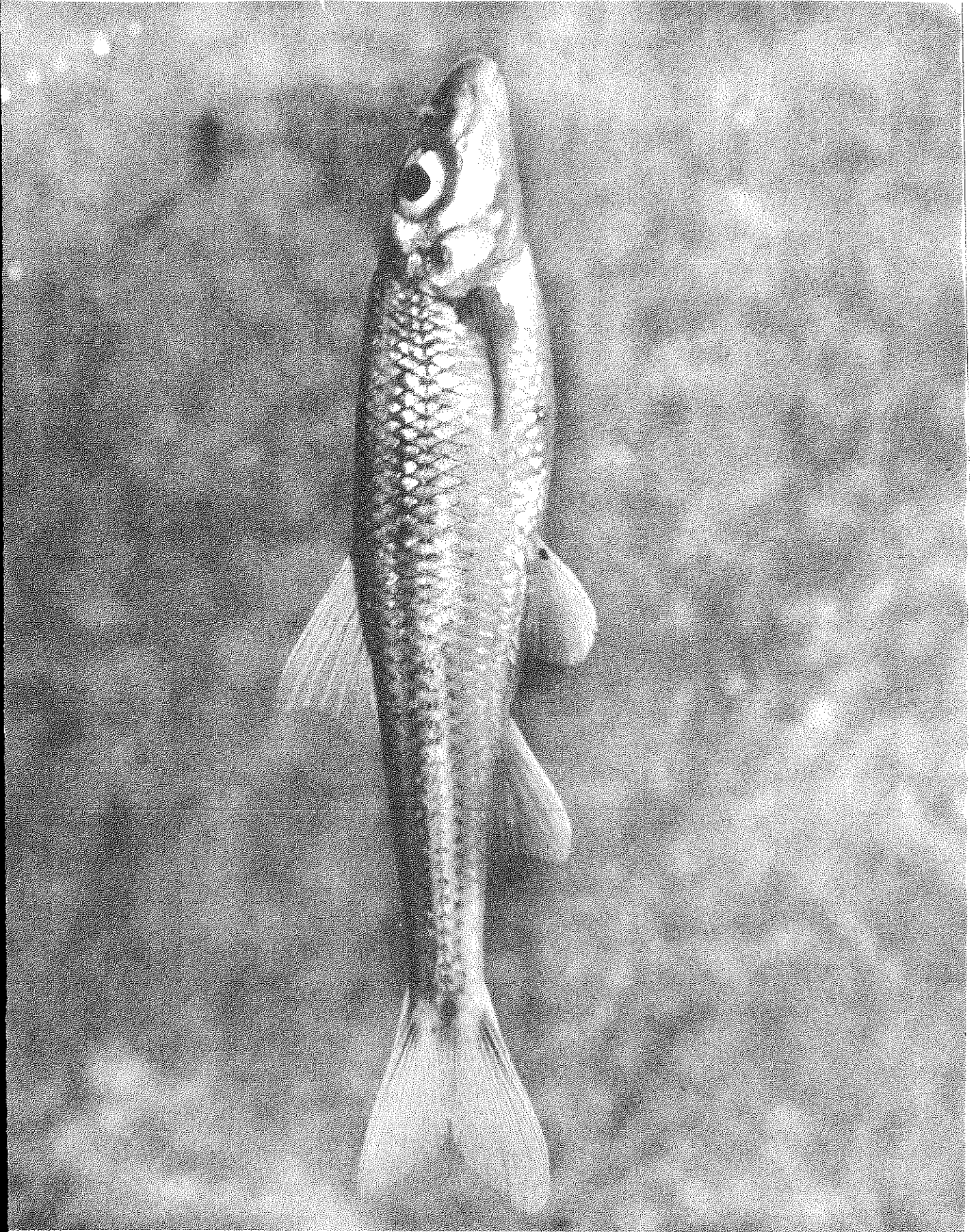
- 2.1 Survey to determine the availability and location of suitable transplant sites. This can include areas for population expansion within rivers where the species presently exists. The first step in the reintroduction of the species will be to locate suitable habitat for transplants. The information collected under Section 1.2.2 will be essential in locating these sites.
- 2.2 Investigate and determine the best method of establishing new populations, i.e., introduction of adults, juveniles, artificially raised individuals, or other means or combinations. Sufficient stock may not be available in the Clinch and Powell Rivers to allow for successful introductions. It may be necessary to artificially rear the slender chub in a hatchery situation and use these individuals for stocking new rivers.
- 2.3 Reestablish species where it is likely it will become established and where needed to meet the recovery objectives. If habitat is available, introductions are likely to succeed, and introductions are needed to meet the recovery objectives, the introduction of the species into the Holston River and sections of the Clinch and Powell Rivers should proceed.
- 2.4 Implement the same protective measures for these introduced populations as outlined for established populations in numbers 1.3 through 1.4 above.

3. Conduct life history studies not covered under section 1.2.2 above, i.e., age and growth, reproductive biology, longevity, natural mortality factors, and population dynamics on a need to know basis. Much of the information needed to manage the species will be available after completion of the tasks outlined in 1.3. However, studies involving specific aspects of the fish's life history may be required to fully understand what is required to recover the slender chub and to evaluate the responses of the species to protective measures.
4. Investigate the necessity for habitat improvement and, if feasible and necessary to meet recovery, develop techniques and sites for habitat improvements and implement. Specific components of the species' habitat may be missing and these may be limiting the potential expansion of the species. Habitat improvement programs and activities may be helpful in alleviating these limiting factors. Because of the impacts from the Cherokee Reservoir, siltation, and pollution problems, habitat improvements may be necessary for transplants to succeed.
5. Develop and implement a program to monitor population levels and habitat conditions of presently established populations as well as introduced and expanding populations. Once recovery actions are implemented, the response of the species and its habitat must be monitored to assess any progress towards recovery. This will likely require an annual census schedule.

6. Annually assess overall success of recovery program and recommend action (adjustment in recovery objectives, delist, continued protection, implement new measures, other studies, etc.). The recovery plan must be evaluated periodically to determine if it is on track and to recommend future actions. Of particular importance is the evaluation of recovery objectives. As information on the species becomes available, changes in recovery objectives can be expected.

Fig. 1. Geochronography of Hybopsis cahnii. Detailed map shows virtually all collections, made by methods that would sample small fishes, from freely flowing parts of lower and middle sections of Clinch and Powell rivers; preimpoundment collections are included. This map omits upper Clinch and Powell collections. Lower map is of Tennessee River, showing full extent of Clinch River and the Holston River record. Solid dots on rivers indicate records of H. cahnii, including some extirpated populations. Off river data are: year of collection(s), preceded by (1) solid dot if H. cahnii taken, (2) open circle if not taken; following the year are (3) number of specimens taken, if any (if specimens were taken more than once in a year, the number of specimens in each collection is given separately, hence indicating the number of collections yielding specimens), and lastly (4) the number of collections, if any, not yielding specimens (this number is separated by a semicolon from number of specimens). TAKEN FROM BURKHEAD AND JENKINS 1982.





Literature Cited

- Ahlstedt, Steven and Steven Brown 1980. The naiad fauna of the Powell River in Virginia and Tennessee (Bivalvia: Unionacea). Amer. Malac Union Bull.
- Burkhead, N. M. and R. E. Jenkins. 1982. Five-year status review of the slender chub, Hybopsis cahni, a threatened cyprinid fish of the upper Tennessee drainage. U.S. Fish Wildl. Serv. Rep., Newton Corner. 27 p.
- Cairns, John, Jr., John S. Crossman, Kenneth L. Dickson, and Edwin E. Henricks. 1971. The recovery of damaged streams. ASB Bull., 18(3):79-106.
- Crossman, J. S., J. Cairns, Jr., and R. J. Daesler. 1973. Aquatic invertebrate recovery in the Clinch River following hazardous spills and floods. VA. Water Resour. Center Bull. 63. 66 p.
- Davis, B. J. and R. J. Miller. 1967. Brain patterns in minnows of the genus Hybopsis in relation to feeding habits and habitats. Copeia, 1967:1-39.
- Etnier, D. A., W. C. Starnes, and B. H. Bauer. 1979. Whatever happened to the silvery minnow (Hybognathus muchalis) in the Tennessee River? SE Fishery Council Proc., 2:1-3.
- Evermann, B. W. and S. F. Hildebrand. 1916. Notes of the fishes of East Tennessee. Bull. U.S. Bur. Fish., 34:431-451.
- U.S. Fish and Wildlife Service. 1977. Endangered and threatened wildlife and plants. Fed. Reg., 42:2507-2511.
- Freedman, D. S., et al. 1974. A time to choose: America's Energy Future. Ballinger Publishing Company, Cambridge, Mass.
- Higgins, J. M. 1978. Water quality progress in the Holston River basin. Tenn. Valley Auth. Tech. Rpt. Ep-78, 42 p.
- Hubbs, C. L. and W. R. Crowe. 1956. Preliminary analysis of the American cyprinid fishes, seven new, referred to the genus Hybopsis, subgenus Erimystax. Occ. Papers Mus. Zool. Univ. Mich. No. 572. 8 p.
- Hurst, Harold H., H. D. Boles, D. A. Etnier, R. Fitz, G. Hickman, W. Starnes, and P. Wilkins. 1979. Snail darter recovery plan. Draft prepared by the snail darter recovery team for U.S. Fish & Wildlife Service. 25 p.
- Jenkins, R. E. 1975. Status report on Hybopsis cahni, the slender chub. Endang. Spec. Off. Rpt., Washington. 13 p.
- Jenkins, R. E. and N. M. Burkhead. ms 1982. The spotfin chub, Hybopsis monacha, a threatened cyprinid fish of the Tennessee River drainage.

Reno, H. W. 1969. Cephalic lateral-line systems of the cyprinid genus Hybopsis. Copeia, 1969:736-773.

Stadnyk, L. 1967. Clinch River fish kill - preliminary report. Unpublished report, Tennessee Game and Fish Commission, 6/27/67, 3 p.

PART III

IMPLEMENTATION SCHEDULE

Priorities within this section (Column 4) have been assigned according to the following:

Priority 1 - Those actions absolutely necessary to prevent extinction of the species.

Priority 2 - Those actions necessary to maintain the species' current status.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Part III Implementation Schedule

Slender Chub

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency		Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	2* Other	FY 1	FY 2	FY 3	
01-04	Continue to utilize existing legislation and regulations to protect species and habitat	1.1	2	continuous	485 SE&ES	Tennessee Valley Authority (TVA) Tn. Wildlife Resources Agcy. (TWRA) Va. Comm. of Game & Inland Fisheries (VCGIF) Tennessee Heritage Program (THP)	1,000	1,000	1,000	*1. See attachment: general categories for Implementation Schedules *2. Other agencies' responsibility would be of a cooperative nature or projects funded under a contract or grant program. In some cases contracts could be let to universities or private enterprises.
I1,I2	Determine species present distribution and status	1.2.1	3	1 yr.	485 SE	TWRA, VCGIF & TVA	6,000	---	---	*3. Note: ALL ESTIMATES ARE FOR FWS FUNDS ONLY
R3,R8, R9,R10 R11	Characterize habitat and determine essential elements	1.2.2	2	2 yr	485 SE	TWRA, VCGIF & TVA	---	5,000	---	
R3,02, M3	Determine the extent of preferred habitat and present information in a manner which identifies areas in need of species attention	1.2.3 & 1.2.4	2	1 yr	485 SE	TWRA, VCGIF & TVA	---	---	2,000	
I12, I14	Determine present and foreseeable threats to species	1.3.1 & 1.3.2 & 1.3.3 & 1.3.4	3		485 SE&ES	TWRA, VCGIF TVA & THP	6,000	---	---	
M3,M7	Determine measures needed to minimize threats and implement where needed to meet recovery	1.3.5	3	Unknown	485 SE	TWRA, VCGIF TVA, THP, & Tenn. & Va. Nature Conservancy (TNC)	---	Unknown	---	

Part III Implementation Schedule

Slender Chub

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Program	Other	FY 1	FY 2	FY 3	
01,04	Solicit help in protecting species and essential habitat	1.4.1 1.4.2 1.4.3 1.4.4	3	continued	485	SE	TWRA, VCGIF & TVA, THP & TNC,	2,000	2,000	2,000	
01	Develop and utilize information and education programs (slide/tape shows, brochures, etc) for local distribution	1.4.5	3	1 yr for devel. continued implementation	485	SE	TWRA, VCGIF & TVA, THP & TNC	5,000	1,000	1,000	
I13	Survey rivers within species' historic range to determine availability of suitable transplant sites	2.1	3	1 yr.	485	SE	TWRA, VCGIF & TVA, THP & TNC	---	5,000	---	
R13, R7	Determine best method of establishing new populations	2.2	3	2 yr.	485	SE	TWRA, VCGIF & TVA & THP	---	---	2,000	Task 2.1 - 2.3 may not be required if other populations are found in task 1.2.1
M2	Reestablish populations within historic range as needed to meet recovery	2.3	3	Unknown	485	SE	TWRA, VCGIF & TVA & THP	---	---	---	
I12, I14 M3, M7	Implement same protective measures for these re-established populations as for known populations	2.4	3	Continuous	485	SE, ES	TWRA, VCGIF & TVA & THP	---	---	---	
R8-R11	Conduct life history studies on a need-to-know basis	3.	3	Unknown	485	SE	TWRA, VCGIF & THP & TVA	---	Unknown	---	These studies will be developed and carried out where there is a specific need for data necessary to reach recovery

Slender Chub

Part III Implementation Schedule

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency		Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Other	FY 1	FY 2	FY 3	
M3	Investigate the need for habitat improvement and implementation only where needed to meet recovery objective	4.	3	Unknown	485 SE	TWRA, VCGIF THP & TVA	---	Unknown	---	
11,12	Develop and implement a monitoring program	5.	3	Unknown	485 SE	TWRA, VCGIF THP & TVA	---	---	5,000	
04	Annual assessment of recovery program and modify where needed	6.	3	Continued	485 SE	TWRA, VCGIF TVA, THP & TNC	500	500	500	

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES *

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

* (Column 1) - Primarily for use by the U.S. Fish and Wildlife Service.

APPENDIX

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